

(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

**EP 0 431 397 B1**

(12)

**EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**30.07.1997 Bulletin 1997/31**

(51) Int Cl.<sup>6</sup>: **H03D 7/16, H03D 1/22**

(21) Application number: **90122236.4**

(22) Date of filing: **21.11.1990**

(54) **Homodyne receiver for cable television converter**

Homodyn-Empfänger für Kabelfernsehumsetzer

Récepteur homodyne pour convertisseur pour télévision à câble

(84) Designated Contracting States:  
**AT BE CH DE DK ES FR GB GR IT LI NL SE**

(30) Priority: **04.12.1989 US 445970**

(43) Date of publication of application:  
**12.06.1991 Bulletin 1991/24**

(73) Proprietor: **GENERAL INSTRUMENT  
CORPORATION OF DELAWARE  
Chicago, Illinois 60602 (US)**

(72) Inventor: **Marz, Daniel  
Dresher, Pennsylvania 19025 (US)**

(74) Representative: **Hoeger, Stellrecht & Partner  
Uhlandstrasse 14 c  
70182 Stuttgart (DE)**

(56) References cited:  
**EP-A- 0 062 872 WO-A-86/01956  
GB-A- 2 091 508 GB-A- 2 192 104**

**EP 0 431 397 B1**

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

## Description

### BACKGROUND OF THE INVENTION

The present invention relates to communication apparatus, and more particularly to a homodyne receiver for use in a cable television converter or the like.

A cable television converter is known from WO86/01956. It converts the received signal to an intermediate frequency higher than the maximum signal frequency. However, this intermediate frequency signal is not recovered at baseband, but converted to the frequency of a locally unused VHF channel.

Homodyne receivers are well known for use in radar applications. Such receivers multiply ("mix") a desired signal by a carrier of the same frequency as the signal. A tunable oscillator, such as a voltage controlled oscillator ("VCO") is used to provide the local oscillator signal providing the mixing frequency. This frequency is mixed with the input signal to provide an in-phase output "I". The local oscillator frequency is also phase shifted by 90° and mixed with the input signal to provide a quadrature output signal "Q". The I and Q signals are processed to recover the desired baseband signal.

Homodyne receivers have not been considered appropriate for use in cable television and similar applications for various reasons. In a homodyne receiver, the frequency spectrum folds over itself when the desired signal is multiplied by a carrier of the same frequency. This result is unacceptable in a television environment, since interference with adjacent television channels would result.

Interference also arises within the desired channel.

A standard homodyne receiver also requires that the 90° phase shift between the I and Q signals be tracked throughout the signal recovery process. This is difficult and expensive to do in a cable television converter.

The cable television band currently spans a frequency range of 50-550 MHz. This range is expected to expand to 50-1000 MHz in the future. A homodyne receiver for use in such a frequency range would have to include a tunable local oscillator and phase shifter operable over the entire cable television band. It would be prohibitively costly to provide a tunable oscillator having such an extended range, where the ratio between the highest and lowest frequencies is greater than 10.

Further, it is much more difficult to control phase noise in a homodyne receiver than in a conventional television receiver. Any spurious signal in the demodulated signal must be -60 dBc, since signals of the same frequency (or within the baseband bandwidth limits) will create spurious products in the desired signal. In order to solve this problem, the harmonics of the tunable local oscillator in a homodyne receiver would have to be 60 dB down. Alternately, switchable filtering would have to be used at the output of the receiver. Neither option is economically feasible.

Use of a homodyne receiver in a cable television or similar application is further complicated in that a high degree of isolation would be required from the mixers and the input amplifier since the local oscillator is at the frequency of the desired channel. The requirement for high quality components renders the use of a conventional homodyne receiver too expensive for cable television applications.

One benefit of a homodyne receiver is that it provides I and Q outputs that are susceptible to digital processing. It is desirable to use digital signal processing in a cable television converter to eliminate adjustments and provide a more reliable, less expensive product. Ideally, the use of digital signal processing would enable a cable television converter/descrambler to be designed using a single VLSI integrated circuit chip.

It would be advantageous to provide a homodyne receiver for use in a cable television converter or the like that provides the benefit of digital signal processing, without the substantial disadvantages inherent in conventional homodyne receivers identified above. The present invention provides such a receiver.

### SUMMARY OF THE INVENTION

In accordance with the present invention, which is defined by the appended claims, apparatus is provided for recovering a baseband signal transmitted on a carrier. The received carrier contains a signal within a first frequency band. The signal is converted to an intermediate frequency above the band, and input to a homodyne detector operating near the intermediate frequency.

The signal is a television signal within the cable television band. The carrier is mixed with a tuning frequency generated by a variable frequency local oscillator, thereby converting a selected television channel signal contained on the carrier to the intermediate frequency. Filter means are provided for limiting the signal input to the homodyne detector to the selected television channel signal.

The homodyne detector comprises a signal splitter coupled to split the converted signal into first and second portions. A fixed frequency local oscillator provides an output frequency near the intermediate frequency. The output frequency is mixed with the first signal portion to provide an in-phase component I. The local oscillator output is phase shifted by 90°, and mixed with the second signal portion to provide a quadrature component Q.

At the output of the homodyne detector, analog to digital converter means are provided for converting the I and Q components to digital signals. The digital signals are processed to provide a demodulated video signal for input to a television set or the like.

In a preferred embodiment, the first frequency band is the cable television band and comprises a range of about 50 MHz to 550 MHz. The intermediate frequency

is at least 1 gigahertz ("GHz") and preferably is about 2 GHz with the homodyne detector operating at about 2.002 GHz.

Typically, the received carrier will contain a plurality of signals in the first frequency band that are upconverted by the apparatus to a second frequency band above the first band. The second frequency band may be chosen, for example, such that the ratio of the highest frequency signal to the lowest frequency signal therein is less than 2.5.

The present invention also provides a method for using a homodyne detector as described above to recover a cable television signal transmitted on a carrier.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of a prior art homodyne receiver;

Figure 2 is a spectral pattern illustrating the operation of the homodyne receiver of Figure 1;

Figure 3 is a block diagram illustrating a homodyne receiver for use in a cable television converter or the like according to the present invention; and

Figure 4 is a block diagram illustrating one embodiment of a digital signal processor that may be used in the receiver of Figure 3.

#### DETAILED DESCRIPTION OF THE INVENTION

In accordance with the present invention, signals transmitted within a first frequency band are upconverted to a frequency band outside of the first frequency band for processing in a homodyne receiver. For example, the cable television band of 50 MHz to 550 MHz can be upconverted to 2.050 GHz to 2.550 GHz. In the higher frequency band, the ratio of the highest frequency signal (2.55 GHz) to the lowest frequency signal (2.05 GHz) is 1.24. This compares favorably to the original ratio of 11 (550/50) and obviates the need for a tunable local oscillator and phase shifter having an extended range. The translation of the received signal to a higher frequency band also reduces or eliminates concerns about interfering harmonics resulting from the operation of a homodyne receiver.

A prior art homodyne receiver 10 is illustrated in Figure 1. A received signal is input at terminal 12 to a filter and amplifier 14 of conventional design. The filtered and amplified signal is split at a splitter 16 into two identical portions. The first portion of the input signal is applied to a mixer 18 where it is multiplied by a carrier output from voltage controlled oscillator ("VCO") 24. This carrier has the same frequency as the input signal.

VCO 24 is used to tune a desired signal from a plurality of signals contained in the input signal. Thus, for example, if an input signal at a frequency of 5 GHz is desired to be recovered, VCO 24 will be tuned to 5 GHz to shift the signal to the beginning of the frequency spectra for subsequent recovery of the baseband signal. An

in-phase component I of the shifted signal will appear at terminal 26.

At the same time, the mixing frequency output from VCO 24 is shifted 90° by phase shift circuitry 22. The 90° phase shifted signal is input to a second mixer 20 for mixing with the input signal, resulting in the output of a quadrature component Q at terminal 28.

The operation of the homodyne receiver of Figure 1 is illustrated on the frequency spectra of Figure 2. An input signal generally designated 30 is centered about a signal frequency 32. The local oscillator frequency (i.e., "carrier") generated by VCO 24 is also at frequency 32. Accordingly, input signal 30 is translated to the beginning of the frequency spectra as shown at 30'. At the same time, the translated spectrum folds over itself as indicated, i.e., signal portion A designated by reference numeral 34 folds over onto signal portion B indicated by reference numeral 36. Those skilled in the art will appreciate that points A and B can be at the same or different frequencies depending on the type of modulation.

Figure 2 also illustrates a signal 40 that appears at the second harmonic 42 of the local oscillator frequency. At the beginning of the frequency spectra, this second harmonic 40' falls into the same portion of the spectrum as the desired input signal 30'. Such interference cannot be tolerated in cable television applications. Accordingly, it has been generally accepted that homodyne receivers are not appropriate for use in cable television and similar applications.

The present invention, as illustrated in Figure 3, overcomes the drawbacks of a conventional homodyne receiver and enables the use of homodyne reception in a cable television environment. A modified homodyne detector generally designated 50 receives a desired input signal at an intermediate frequency above the frequency band in which the input signal is transmitted. The input signal is received at terminal 52, and filtered and amplified in conventional circuitry 54. In accordance with the present invention, a tuning frequency present at the output of tunable oscillator 58 (for example, a VCO) is mixed with the input signal at mixer 56. The purpose of oscillator 58 and mixer 56 is to upconvert the incoming signal spectrum to a frequency band above that of the incoming signal. For example, where input terminal 52 receives an incoming band of signals at cable television frequencies (e.g., 50-550 MHz) homodyne detector 50 must operate far enough above this band to avoid harmonic distortion of the television channel signals upon detection. Thus, for example, oscillator 58 can be tunable from 2.05 to 2.55 GHz to enable the translation of any selected television channel within the 50-550 MHz band to an intermediate frequency of 2.0 GHz. If it is desired to select television channel 3, which resides in a 6 MHz channel commencing at 60 MHz, oscillator 58 is tuned to 2.06 GHz for recovery of the channel 3 signal at the 2.0 GHz intermediate frequency. It is noted that the range of oscillator 58 need only be 1.24 : 1 to provide the swing from 2.05 to 2.55 GHz. This swing

enables tuning over the entire 50-550 MHz CATV band.

An IF filter 60 receives the upconverted spectrum received from mixer 56 and outputs a single channel to homodyne detector 50. In the example given, IF filter 60 is tuned to eliminate most of the undesired spectrum and pass the channel signal appearing at the intermediate frequency of 2.0 GHz.

The desired, upconverted channel signal is split at a splitter 62 into first and second portions. The first portion of the signal is input to a mixer 64. The second portion is input to a mixer 66. A fixed local oscillator 70 provides a carrier for mixing with the upconverted channel signal. The carrier frequency is at or near the intermediate frequency passed by IF filter 60. In a preferred embodiment where the intermediate frequency is 2.0 GHz, local oscillator 70 is tuned to 2.002 GHz so that the desired television channel signal processed by homodyne detector 50 will end up folded on the frequency spectrum for recovery without interference from an adjacent channel. As indicated in Figure 3, the output of local oscillator 70 directly feeds mixer 64. The local oscillator output is shifted 90° by phase shifting circuitry 68 before input to mixer 66. The resultant I and Q components are input to a digital signal processor 72 for recovery of the original video signal. The recovered video signal is output to a television receiver or the like on output terminal 74.

It is noted that in the homodyne detector of Figure 3, a fixed local oscillator 70 is provided and tuning of a desired channel occurs at mixer 56, which is prior to the homodyne detector. Although the circuit of Figure 3 requires two separate oscillators, only one high quality mixer 56 is required. Mixers 64 and 66 can be simple mixers (e.g., dual gate mosfets, mesfets, or bipolar devices) instead of the high quality mixers required in conventional homodyne receivers such as that shown in Figure 1.

Figure 4 illustrates one example of a digital signal processor 72 in block diagram form. The I component of the detected signal is input from terminal 80 to an analog to digital ("A/D") converter 84 which converts the signal into a digital (e.g., 8 bit) format. The digitized signal can be expressed as  $V\sin\beta$ , where  $\beta = (\Omega_{LO} - \Omega_C)t$ .  $\Omega_{LO}$  is the frequency of local oscillator 70 and  $\Omega_C$  is the intermediate frequency.

After A/D conversion, the I signal is passed through a bandpass filter 86. For cable television applications, this filter is tuned to 2.15 MHz. The output of bandpass filter 86 is coupled to a digital phase lock loop 88 that phase locks to the incoming 2.15 MHz signal and generates 0 and 90° components corresponding to  $\sin\beta$  and  $\cos\beta$ . The  $\sin\beta$  component is multiplied in a mixer 90 with the  $V\sin\beta$  signal from A/D converter 84. The resultant output  $V\sin^2\beta$  is input to a summing circuit 96.

The Q component output from homodyne detector 50 is input at terminal 82 to an analog to digital converter 92. The resultant digital signal is equivalent to  $V\cos\beta$ , and is multiplied by  $\cos\beta$  at mixer 94. The resultant  $V\cos^2\beta$  signal is input to summing circuit 96. When the

$V\sin^2\beta$  and  $V\cos^2\beta$  terms are added at summing circuit 96, the resultant output on terminal 98 is the recovered desired signal V.

It will now be appreciated that the present invention provides a method and apparatus for recovering baseband signals in cable television and similar applications using a unique homodyne detector operating in a frequency band above that in which the transmitted signals are located. Properties of prior art homodyne receivers which render them inappropriate for use in cable television applications are overcome by the present invention. The invention provides an economical apparatus for use in a cable television converter or the like that enables digital processing of detected television signals with the attendant advantages thereof.

Although the invention has been described in connection with a preferred embodiment, it will be apparent to those skilled in the art that various modifications and adaptations may be made thereto without departing from the scope of the following claims.

#### Claims

1. Apparatus for recovering a cable television signal transmitted on a carrier comprising:

means for receiving (52) a carrier containing a signal within a cable television frequency band;  
means for upconverting (56, 58) said signal to an intermediate frequency and  
means for inputting the upconverted signal to a converting circuit (50), said converting circuit comprising at least one mixing means (64) and a local oscillator (70) generating an output signal at a fixed frequency

characterized in

that said intermediate frequency is located sufficiently above said cable television band to prevent distortion of said cable television signal by harmonics when recovered at baseband;  
that said local oscillator (70) of said converting circuit has an output signal at a fixed frequency that is offset above said intermediate frequency by a certain amount, said certain amount being chosen such that the signal when translated to baseband has a folded spectrum in which the desired television channel is folded over itself to avoid interference with adjacent channels in the folded spectrum;  
that said converting circuit is a modified homodyne detector (50) for converting said upconverted signal to baseband, said modified homodyne detector comprising a signal splitter (62) coupled to split the upconverted signal into first and second signal portions, said modified ho-

moddyne detector further comprising said at least one mixing means (64) for mixing said local oscillator output signal with a first signal portion to provide an analog inphase component (I), said modified homodyne detector further comprising means (68) for phase shifting the local oscillator output signal by 90° and said modified homodyne detector further comprising a second mixing means (66) for mixing the 90° phase shifted output signal with said second signal portion to provide an analog quadrature component (Q); and that a digital signal processor (72) is provided for recovery of the original video signal from said analog inphase component (I) and said analog quadrature component (Q).

2. The apparatus of claim 1 wherein said upconverting means comprises a mixer (56) coupled to mix said carrier with a tuning frequency generated by a variable frequency local oscillator (58) for converting a selected television channel signal contained on said carrier to said intermediate frequency.
3. The apparatus of any of the preceding claims further comprising:  
filter means (60) coupled between said upconverting means (56, 58) and said inputting means for limiting the signal input to the modified homodyne detector (50) to said selected television channel signal.
4. The apparatus of any of the preceding claims further comprising:  
analog to digital converter means (84, 92) for converting said inphase (I) and quadrature (Q) components to digital signals; and  
means (86, 88, 90, 94, 96) for processing said digital signals to provide a demodulated video signal.
5. The apparatus of any of the preceding claims wherein said cable television frequency band comprises a range of about 50 MHz to 550 MHz.
6. The apparatus of any of the preceding claims wherein said intermediate frequency is at least 1 GHz.
7. The apparatus of claim 6, wherein said intermediate frequency is about 2 GHz and said modified homodyne detector (50) operates at about 2.002 GHz.
8. The apparatus of any of the preceding claims wherein said upconverting means (56, 58) upconverts a plurality of signals contained on said carrier in said cable television frequency band to a second

frequency band above the cable television band.

9. The apparatus of claim 8 wherein the ratio of the highest frequency signal to the lowest frequency signal in said second band is less than 2.5.
10. The apparatus of any of claims 1 to 9 wherein said modified homodyne detector (50) operates at a frequency of about 2 MHz above the intermediate frequency.
11. A method for recovering a cable television signal transmitted on a carrier comprising the steps of:

receiving a carrier containing a plurality of cable television signals within a first cable television frequency band;  
upconverting said cable television signals to a second frequency band above said first band wherein a selected one of said upconverted signals will reside at an intermediate frequency within said second band;  
and inputting the selected upconverted signal to a converting circuit (50) operating at a fixed frequency;

characterized in

that said intermediate frequency is located sufficiently above said cable television band to prevent distortion of said cable television signal by harmonics when recovered at baseband;  
that said fixed frequency is offset above said intermediate frequency by a certain amount, said certain amount being chosen such that the signal when translated to baseband has a folded spectrum in which the desired television channel is folded over itself to avoid interference with adjacent channels in the folded spectrum;  
that said selected signal is converted to baseband by a modified homodyne detector (50) used as said converting circuit;  
that analog inphase (I) and analog quadrature (Q) signals are generated by said modified homodyne detector (50);  
and that said analog in phase (I) and analog quadrature (Q) signals are processed by a digital signal processor (72) to provide a demodulated video signal.

12. A method according to claim 11 wherein said first frequency band comprises a range of about 50 MHz to 550 MHz.
13. A method according to any of claims 11 or 12 wherein said intermediate frequency is at least 1 GHz.

14. A method according to claim 13 wherein said intermediate frequency is about 2 GHz and said homodyne detector operates at about 2.002 GHz.
15. A method according to any of claims 11 to 14 where-  
in said signals are upconverted to a frequency  
range where the ratio of the highest frequency signal to the lowest frequency signal in said second band is less than 2.5.
16. A method according to any of claims 11 to 15, wherein said modified homodyne detector (50) operates at a frequency of about 2 MHz above the intermediate frequency.

#### Patentansprüche

1. Vorrichtung zum Wiederherstellen eines Kabelfernsehsignals, das auf einem Träger übertragen wird, welche umfaßt:

ein Mittel (52) zum Empfangen eines Trägers, welcher ein Signal innerhalb eines Kabelfernsehfrequenzbandes aufweist;

ein Mittel (56, 58) zum Aufwärtsmischen des Signals auf eine Zwischenfrequenz und

ein Mittel zum Eingeben des aufwärtsgemischten Signals an einen Konversionsschaltkreis (50), wobei der Konversionsschaltkreis mindestens ein Mischmittel (64) und einen Lokaloszillator (70), der ein Ausgangssignal bei einer festen Frequenz erzeugt, umfaßt,

#### dadurch gekennzeichnet,

daß die Zwischenfrequenz genügend oberhalb des Kabelfernsehbandes lokalisiert ist, um Verzerrung des Kabelfernsehsignals durch Harmonische zu verhindern, wenn es bei Basisband wiederhergestellt wird;

daß der Lokaloszillator (70) des Konversionsschaltkreises ein Ausgangssignal bei einer festen Frequenz hat, die über der Zwischenfrequenz um einen bestimmten Betrag versetzt ist, wobei der bestimmte Betrag so gewählt ist, daß das Signal, wenn es auf Basisband überführt wird, ein gefaltetes Spektrum aufweist, in dem der gewünschte Fernsehkanal über sich selbst gefaltet ist, um Interferenz mit benachbarten Kanälen in dem gefalteten Spektrum zu vermeiden;

daß der Konversionsschaltkreis ein modifizierter Homodyndetektor (50) zum Konvertieren

des aufwärtsgemischten Signals auf Basisband ist, wobei der modifizierte Homodyndetektor einen Signalteiler (62) aufweist, der angekoppelt ist, um das aufwärtsgemischte Signal in erste und zweite Signalanteile zu teilen, wobei der modifizierte Homodyndetektor weiter das mindestens eine Mischmittel (64) zum Mischen des Lokaloszillatorausgangssignals mit einem ersten Signalanteil umfaßt, um eine analoge In-Phase-Komponente (I) bereitzustellen, wobei der modifizierte Homodyndetektor weiter ein Mittel (68) zum Phasenverschieben des Lokaloszillatorausgangssignals um 90° umfaßt und wobei der modifizierte Homodyndetektor weiter ein zweites Mischmittel (66) zum Mischen des 90°-phasenverschobenen Ausgangssignals mit dem zweiten Signalanteil umfaßt, um eine analoge Quadratur-Komponente (Q) bereitzustellen;

und daß ein digitaler Signalprozessor (72) vorgesehen ist zur Wiederherstellung des originalen Videosignals aus der analogen In-Phase-Komponente (I) und der analogen Quadratur-Komponente (Q).

2. Vorrichtung nach Anspruch 1, wobei das aufwärtsmischende Mittel einen Mischer (56) umfaßt, der angekoppelt ist, um den Träger mit einer Abstimmfrequenz zu mischen, die durch einen Lokaloszillator (58) mit variabler Frequenz erzeugt wird, um ein ausgewähltes Fernsehkanalsignal, welches auf dem Träger enthalten ist, auf die Zwischenfrequenz zu konvertieren.

3. Vorrichtung nach einem der vorangehenden Ansprüche, welche weiter umfaßt:  
ein Filtermittel (60), welches zwischen das aufwärtsmischende Mittel (56, 58) und das eingebende Mittel gekoppelt ist, zum Begrenzen des Signaleingangs an den modifizierten Homodyndetektor (50) auf das ausgewählte Fernsehkanalsignal.

4. Vorrichtung nach einem der vorangehenden Ansprüche, welche weiter umfaßt:  
Analog- in Digitalwandlermittel (84, 92) zum Konvertieren der In-Phase- (I) und Quadratur-Komponenten (Q) in digitale Signale; und ein Mittel (86, 88, 90, 94, 96) zum Verarbeiten der Digitalsignale, um ein demoduliertes Videosignal bereitzustellen.

5. Vorrichtung nach einem der vorangehenden Ansprüche, wobei das Kabelfernsehfrequenzband einen Bereich von ungefähr 50 MHz bis 550 MHz umfaßt.

6. Vorrichtung nach einem der vorangehenden Ansprüche, wobei die Zwischenfrequenz mindestens

1 GHz ist.

7. Vorrichtung nach Anspruch 6, wobei die Zwischenfrequenz ungefähr 2 GHz ist und der modifizierte Homodyndetektor (50) bei ungefähr 2,002 GHz in Betrieb ist. 5
8. Vorrichtung nach einem der vorangehenden Ansprüche, wobei das aufwärtsmischende Mittel (56, 58) eine Mehrzahl von Signalen, die auf dem Träger in dem Kabelfernsehfrequenzband enthalten sind, aufwärtsmischt auf ein zweites Frequenzband über dem Kabelfernsehfrequenzband. 10
9. Vorrichtung nach Anspruch 8, wobei das Verhältnis des höchsten Frequenzsignals zu dem niedersten Frequenzsignal in dem zweiten Band weniger als 2,5 ist. 15
10. Vorrichtung nach einem der Ansprüche 1 bis 9, wobei der modifizierte Homodyndetektor (50) bei einer Frequenz von ungefähr 2 MHz oberhalb der Zwischenfrequenz in Betrieb ist. 20
11. Verfahren zum Wiederherstellen eines auf einem Träger übertragenen Kabelfernsehsignals, welches die Schritte umfaßt: 25

Empfangen eines Trägers, der eine Mehrzahl von Kabelfernsehsignalen innerhalb eines ersten Kabelfernsehfrequenzbandes aufweist; 30

Aufwärtsmischen der Kabelfernsehsignale auf ein zweites Frequenzband über dem ersten Band, wobei ein ausgewähltes Signal der aufwärtsgemischten Signale bei einer Zwischenfrequenz innerhalb des zweiten Bandes liegt; 35

und Eingeben des ausgewählten aufwärtsgemischten Signals an einen Konversionsschaltkreis (50), welcher auf einer festen Frequenz in Betrieb ist, 40

**dadurch gekennzeichnet,**

daß die Zwischenfrequenz genügend oberhalb des Kabelfernsehfrequenzbandes lokalisiert ist, um Verzerrung des Kabelfernsehsignals durch Harmonische zu verhindern, wenn es bei Basisband wiederhergestellt wird; 50

daß die feste Frequenz um einen bestimmten Betrag über die Zwischenfrequenz versetzt ist, wobei der bestimmte Betrag so gewählt ist, daß das Signal, wenn es auf Basisband überführt wird, ein gefaltetes Spektrum hat, in dem der gewünschte Fernsehkanal über sich selbst gefaltet ist, um Interferenz mit benachbarten Ka- 55

nälen in dem gefalteten Spektrum zu vermeiden;

daß das ausgewählte Signal durch einen modifizierten Homodyndetektor (50), welcher als der Konversionsschaltkreis benutzt wird, auf Basisband konvertiert wird;

daß analoge In-Phase- (I) und analoge Quadratur-Signale (Q) durch den modifizierten Homodyndetektor (50) erzeugt werden;

und daß die analogen In-Phase- (I) und analogen Quadratur-Signale (Q) durch einen digitalen Signalprozessor (72) verarbeitet werden, um ein demoduliertes Videosignal bereitzustellen.

12. Verfahren nach Anspruch 11, wobei das erste Frequenzband einen Bereich von 50 MHz bis 550 MHz umfaßt.
13. Verfahren nach Anspruch 11 oder 12, wobei die Zwischenfrequenz mindestens 1 GHz ist.
14. Verfahren nach Anspruch 13, wobei die Zwischenfrequenz ungefähr 2 GHz ist und der Homodyndetektor ungefähr bei 2,002 GHz in Betrieb ist.
15. Verfahren nach einem der Ansprüche 11 bis 14, wobei die Signale auf einen Frequenzbereich aufwärtsgemischt werden, bei dem das Verhältnis des höchsten Frequenzsignals zu dem niedersten Frequenzsignal in dem zweiten Band kleiner als 2,5.
16. Verfahren nach einem der Ansprüche 11 bis 15, wobei der modifizierte Homodyndetektor (50) bei einer Frequenz von ungefähr 2 MHz über der Zwischenfrequenz in Betrieb ist.

## Revendications

1. Dispositif pour récupérer un signal de télévision par câble, transmis sur une porteuse, comprenant: 45

des moyens (52) pour recevoir une porteuse contenant un signal dans une bande de fréquences de télévision par câble,

des moyens (56, 58) pour convertir, avec accroissement de la fréquence d'entrée de la porteuse, le signal jusqu'à une fréquence intermédiaire, et

des moyens pour introduire le signal converti, avec accroissement de la fréquence d'entrée de la porteuse, dans un circuit de conversion (50), le circuit de conversion comprenant au minimum un moyen de mélange (64) et un oscilla-

teur local (70) produisant un signal de sortie à une fréquence fixée,

caractérisé en ce que :

ladite fréquence intermédiaire est située suffisamment au-dessus de la bande de télévision par câble pour empêcher une distorsion du signal de télévision par câble par des harmoniques, lors d'une récupération dans la bande de base,

l'oscillateur local (70) du circuit de conversion a un signal de sortie à une fréquence fixée qui est décalée, d'une certaine valeur, au-dessus de la fréquence intermédiaire, ladite certaine valeur étant choisie de façon à ce que le signal, lorsqu'il est transposé dans la bande de base, a un spectre replié dans lequel le canal de télévision désiré est replié sur lui-même pour éviter une interférence avec des canaux adjacents dans le spectre replié,

le circuit de conversion est un détecteur synchrone modifié (50) destiné à convertir le signal converti, avec accroissement de la fréquence d'entrée de la porteuse, en une bande de base, le détecteur synchrone modifié comprenant un moyen de dédoublement de signal (62) raccordé pour dédoubler le signal converti, avec accroissement de la fréquence d'entrée de la porteuse, en des première et seconde parties de signal, le détecteur synchrone modifié comprenant en outre le moyen de mélange (64) minimum pour mélanger le signal de sortie de l'oscillateur local et une première partie de signal afin de fournir une composante analogique en phase (I), le détecteur synchrone modifié comprenant en outre un moyen (68) pour décaler de 90° la phase du signal de sortie de l'oscillateur local et le détecteur synchrone modifié comprenant en outre un second moyen de mélange (66) pour mélanger le signal de sortie déphasé de 90° et la seconde partie de signal afin de procurer une composante analogique en quadrature (Q),

et un processeur de signal numérique (72) est prévu pour la récupération du signal vidéo de départ à partir de la composante analogique en phase (I) et de la composante analogique en quadrature (Q).

2. Dispositif suivant la revendication 1, caractérisé en ce que le moyen de conversion, avec accroissement de la fréquence d'entrée de la porteuse, comprend un mélangeur (56) raccordé pour mélanger la porteuse et une fréquence de syntonisation produite par un oscillateur local (58) à fréquence variable, en vue de convertir en la fréquence intermédiaire un signal de canal de télévision choisi conte-

nu dans la porteuse.

3. Dispositif suivant l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend en outre un moyen de filtrage (60) raccordé entre le moyen (56, 58) de conversion, avec accroissement de la fréquence d'entrée de la porteuse, et le moyen d'introduction, en vue de limiter le signal introduit dans le détecteur synchrone modifié (50) au signal de canal de télévision choisi.

4. Dispositif suivant l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend en outre un moyen de conversion analogique/numérique (84, 92) pour convertir les composantes en phase (I) et en quadrature (Q) en des signaux numériques, et

un moyen (86, 88, 90, 94, 96) pour traiter les signaux numériques afin de fournir un signal vidéo démodulé.

5. Dispositif suivant l'une quelconque des revendications précédentes, caractérisé en ce que la bande de fréquences de télévision par câble comprend une plage d'approximativement 50MHz à 550 MHz.

6. Dispositif suivant l'une quelconque des revendications précédentes, caractérisé en ce que la fréquence intermédiaire précitée est d'au moins 1 GHz.

7. Dispositif suivant la revendication 6, caractérisé en ce que la fréquence intermédiaire est d'approximativement 2 GHz et en ce que le détecteur synchrone modifié (50) fonctionne à approximativement 2,002 GHz.

8. Dispositif suivant l'une quelconque des revendications précédentes, caractérisé en ce que le moyen (56, 58) de conversion, avec accroissement de la fréquence d'entrée de la porteuse, convertit une pluralité de signaux contenus dans la porteuse, dans la bande de fréquences de télévision par câble, en une seconde bande de fréquences au-dessus de la bande de télévision par câble.

9. Dispositif suivant la revendication 8, caractérisé en ce que le rapport entre le signal de fréquence le plus élevé et le signal de fréquence le plus bas, dans la seconde bande, est de moins de 2,5.

10. Dispositif suivant l'une quelconque des revendications 1 à 9, caractérisé en ce que le détecteur synchrone modifié (50) fonctionne à une fréquence d'approximativement 2 MHz au-dessus de la fréquence intermédiaire.

11. Procédé de récupération d'un signal de télévision



par câble transmis sur une porteuse, comprenant les étapes de :

recevoir une porteuse comprenant une pluralité de signaux de télévision par câble, dans une première bande de fréquences de télévision par câble,  
convertir, avec accroissement de la fréquence d'entrée de la porteuse, les signaux de télévision par câble précités en une seconde bande de fréquences au-dessus de la première bande précitée, un signal sélectionné desdits signaux convertis se situant à l'endroit d'une fréquence intermédiaire dans la seconde bande,  
et introduire le signal converti sélectionné dans un circuit de conversion (50) fonctionnant à une fréquence fixe,

caractérisé en ce que :

ladite fréquence intermédiaire est située suffisamment au-dessus de la bande de télévision par câble enfin d'empêcher une distorsion du signal de télévision par câble par des harmoniques lors d'une récupération à l'endroit de la bande de base,

la fréquence fixe est décalée d'une certaine valeur au-dessus de la fréquence intermédiaire, ladite certaine valeur étant choisie de façon à ce que le signal, lorsqu'il est transposé dans la bande de base, a un spectre replié dans lequel le canal de télévision souhaité est replié sur lui-même pour éviter une interférence avec des canaux adjacents dans le spectre replié,  
ledit signal sélectionné est converti en une bande de base par un détecteur synchrone modifié (50) utilisé en tant que circuit de conversion précité,

des signaux analogiques en phase (I) et analogiques en quadrature (Q) sont produits par le détecteur synchrone modifié (50), et les signaux analogiques en phase (I) et analogiques en quadrature (Q) sont traités par un processeur de signal numérique (72) pour fournir un signal vidéo démodulé.

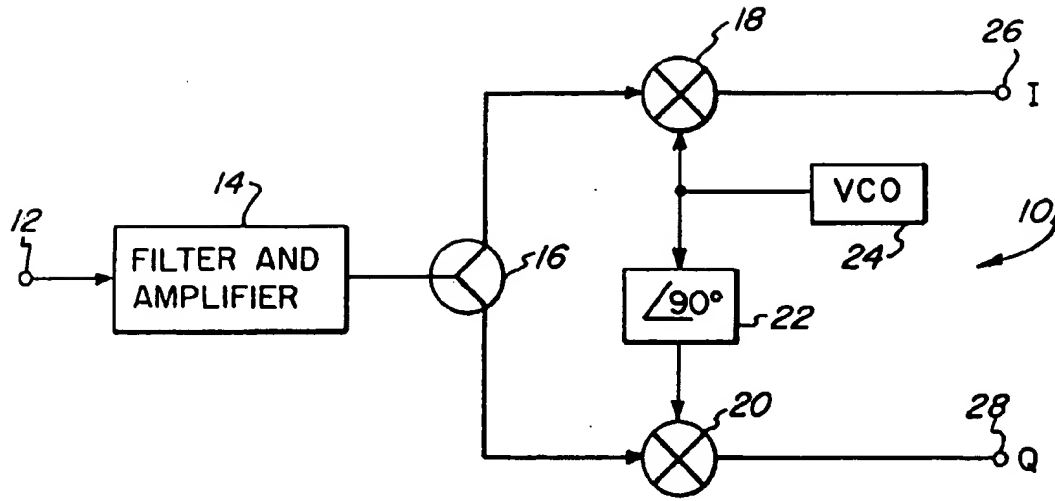
12. Procédé suivant la revendication 11, caractérisé en ce que la première bande de fréquences comprend une plage d'approximativement 50 MHz à 550 MHz.

13. Procédé suivant l'une quelconque des revendications 11 et 12, caractérisé en ce que la fréquence intermédiaire est située à au moins 1 GHz.

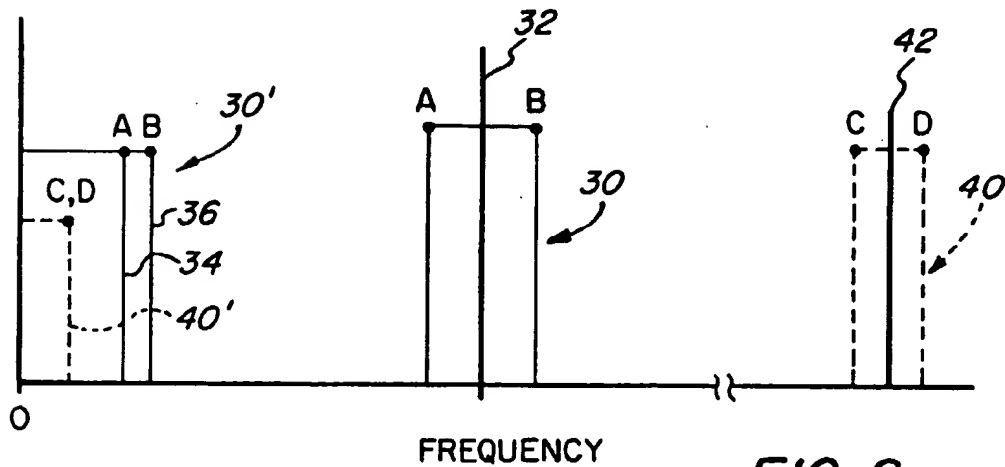
14. Procédé suivant la revendication 13, caractérisé en ce que la fréquence intermédiaire est à approximativement 2 GHz et en ce que le détecteur synchrone fonctionne à approximativement 2,002 GHz.

15. Procédé suivant l'une quelconque des revendications 11 à 14, caractérisé en ce que les signaux sont convertis, avec accroissement de la fréquence d'entrée de la porteuse, jusqu'à une plage de fréquences dans laquelle le rapport entre le signal de fréquence la plus élevée et le signal de fréquence la plus basse, dans la seconde bande, est inférieur à 2,5.

16. Procédé suivant l'une quelconque des revendications 11 à 15, caractérisé en ce que le détecteur synchrone modifié (50) fonctionne à une fréquence d'approximativement 2 MHz au-dessus de la fréquence intermédiaire.



**FIG. 1**  
(PRIOR ART)



**FIG. 2**

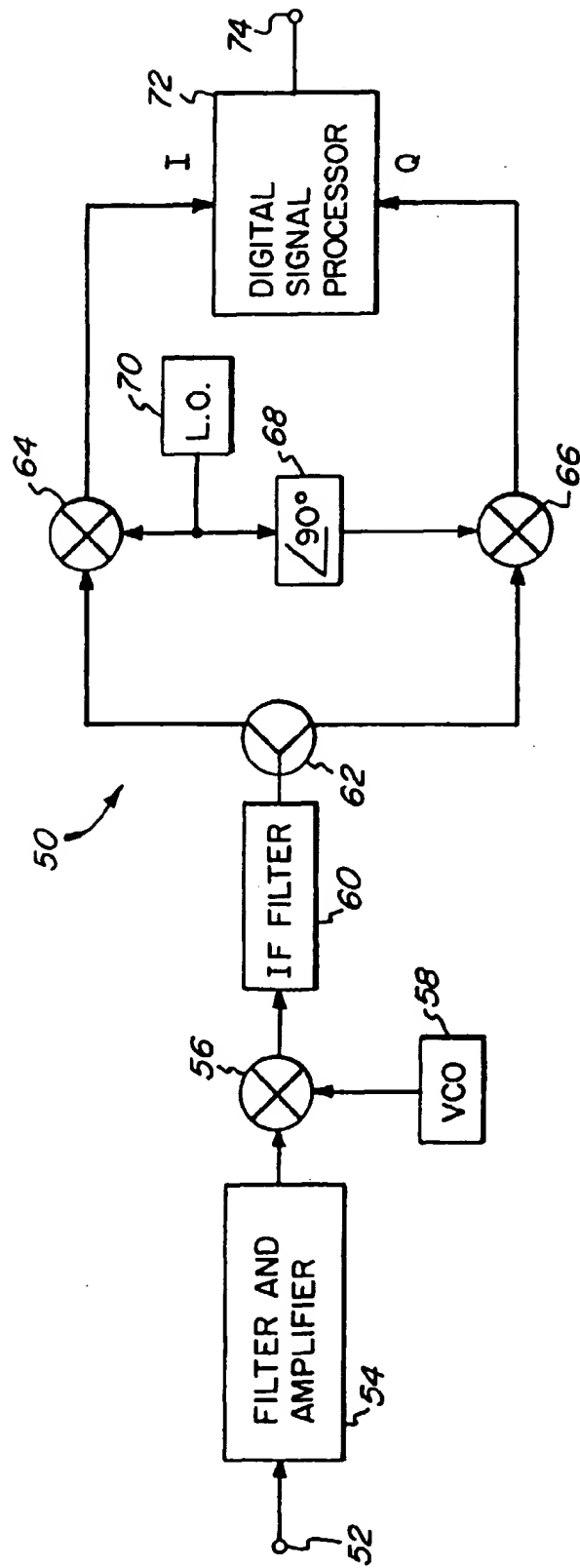


FIG. 3

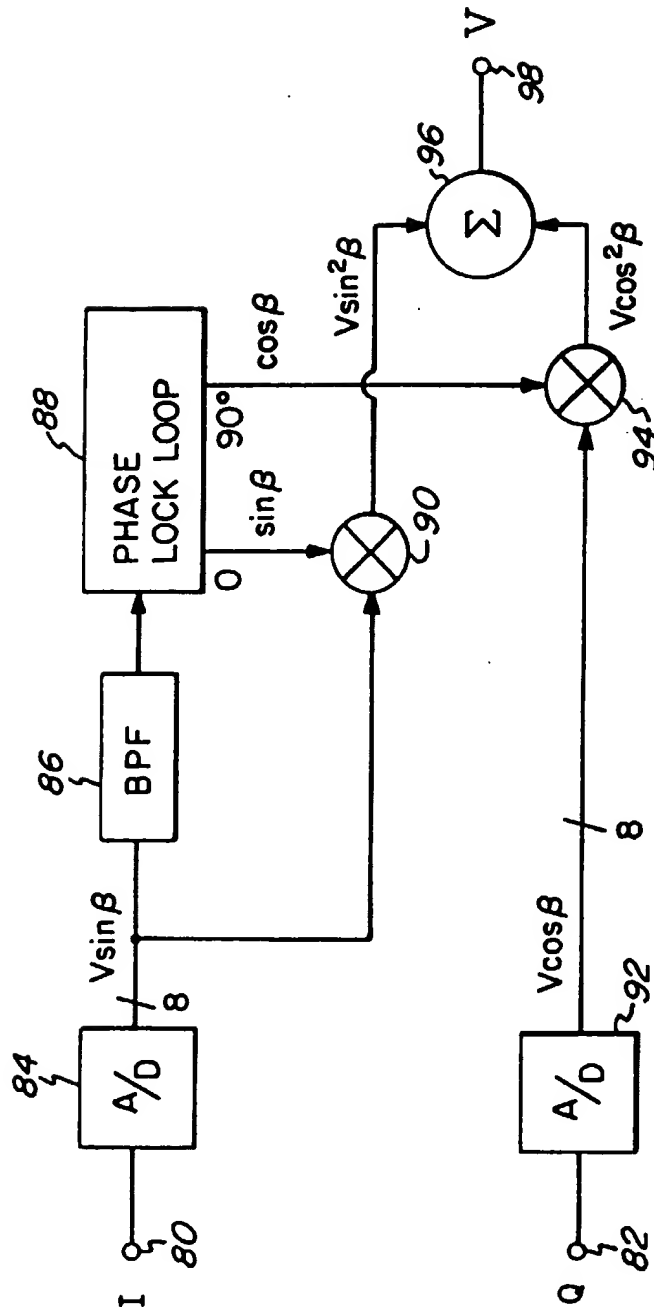


FIG. 4